

What is claimed is:

- 1           1.     A satellite based positioning method, comprising:  
2           a mobile station using stored satellite sub-almanacs to acquire a plurality of  
3     satellites;  
4           the mobile station using the satellite sub-almanacs to take measurements;  
5           the mobile station using the sub-almanacs to calculate a coarse position of the  
6     mobile station; and  
7           the mobile station transmitting the coarse position to a network.
- 1           2.     The method of claim 1, wherein the mobile station further stores the  
2     coarse position, and wherein the mobile station transmits the coarse position to the  
3     network after a period of time.
- 1           3.     The method of claim 1, further comprising:  
2           the network calculating a correction to the coarse position; and  
3           the network transmitting the correction to the mobile station.
- 1           4.     The method of claim 1, further comprising:  
2           determining whether any of the sub-almanacs require replacement; and  
3           transmitting and required replacement sub-almanacs to the mobile station.
- 1           5.     The method of claim 4, further comprising the mobile station transmitting  
2     an indication of an acceptable level of error to the network, wherein determining whether

3 any of the sub-almanacs requires replacement includes determining whether the  
4 acceptable level of error has been exceeded.

1 6. The method of claim 1, further comprising:  
2 the mobile station receiving a reference position; and  
3 the mobile station using the reference position to calculate the coarse position.

1 7 The method of claim 6, wherein the mobile station transmitting the coarse  
2 position comprises transmitting a position difference between the reference position and  
3 the coarse position.

1 8. The method of claim 3, further comprising the mobile station transmitting  
2 an identification list to the network, wherein the identification list comprises  
3 identifications of particular satellites used in calculating the coarse position, and  
4 identifications of particular sub-almanacs for each of the particular satellites.

1 9. The method of claim 8, wherein calculating the correction comprises  
2 calculating a position correction vector over satellites used to calculate the coarse  
3 position.

1 10. The method of claim 8, wherein calculating the correction comprises  
2 calculating a pseudorange correction for each satellite used to calculate the coarse  
3 position.

1 11. The method of claim 8, wherein calculating the correction comprises  
2 calculating a differential correction, wherein the differential correction accounts for

3 discrepancies between calculation results obtained using ephemeris data and pseudorange  
4 data observed by a reference receiver at a known location.

1       12.     A satellite based positioning system, comprising:  
2       a location server in a network, wherein the location server receives satellite  
3 positioning data, including global positioning system (GPS) data;  
4       a base station in the network;  
5       a mobile station configured to communicate with the base station, wherein the  
6 mobile station comprises,  
7       a memory that stores satellite sub-almanac data;  
8       a central processing unit (CPU) configured to calculate a coarse position  
9 using the sub-almanac data; and  
10       a transceiver configured to transmit the coarse position to the network.

1       13.     The system of claim 12, wherein the location server is configured to  
2 calculate a correction to the coarse position.

1       14.     The system of claim 13, wherein the mobile station is further configured  
2 to transmit an identification list to the network, wherein the identification list comprises  
3 identifications of particular satellites used in calculating the coarse position, and  
4 identification of particular sub-almanacs for each of the particular satellites.

1       15.     The system of claim 14, wherein the location server is configured to  
2 determine whether any of the sub-almanacs require replacement, and to transmit any  
3 required replacement sub-almanacs to the mobile station.

1           16.     The system of claim 15, wherein the mobile station is further configured  
2     to transmit an indication of an acceptable level of error to the network, and wherein  
3     determining whether any of the sub-almanacs requires replacement includes determining  
4     whether the acceptable level of error has been exceeded.

1           17.     The system of claim 12, wherein the mobile station is further configured  
2     to receive a reference position, and to use the reference position to calculate the coarse  
3     position.

1           18     The system of claim 17, wherein transmitting the coarse position  
2     comprises transmitting a position difference between the reference position and the  
3     coarse position.

1           19.     The system of claim 16, further comprising the mobile station transmitting  
2     an identification list to the network, wherein the identification list comprises  
3     identifications of particular satellites used in calculating the coarse position, and  
4     identification of particular sub-almanacs for each of the particular satellites.

1           20.     The system of claim 19, wherein calculating the correction comprises  
2     calculating a position correction vector over satellites used to calculate the coarse  
3     position.

1           21.     The system of claim 19, wherein calculating the correction comprises  
2     calculating a pseudorange correction for each satellite used to calculate the coarse  
3     position.

1           22.     The system of claim 19, wherein calculating the correction comprises  
2     calculating a differential correction, wherein the differential correction accounts for  
3     discrepancies between calculation results obtained using ephemeris data and pseudorange  
4     data observed by a reference receiver at a known location.

1           23.     A method of determining a position of a mobile station, the method  
2     comprising:  
3             the mobile station storing sub-almanac data;  
4             the mobile station using the sub-almanac data to calculate a coarse position;  
5             the mobile station transmitting the coarse position and an identification list to a  
6     network, wherein the identification list comprises identifications of particular satellites  
7     used in calculating the coarse position, and identifications of particular sub-almanacs for  
8     each of the particular satellites;  
9             the network calculating an estimated range error per satellite; and  
10            if the estimated range error exceeds a predetermined threshold for particular sub-  
11     almanacs, transmitting replacement sub-almanacs to the mobile station.

1           24.     The method of claim 23, further comprising, if the estimated range error  
2     does not exceed the predetermined threshold for any of the sub-almanacs, calculating a  
3     final position solution for the mobile station.

1           25.     The method of claim 23, further comprising:  
2             re-transmitting a position request to the mobile station; and

3           the mobile station recalculating a coarse position using the replacement sub-  
4 almanacs.

1           26.     A satellite based positioning method for a mobile station in  
2 communication with a network, the method comprising:

3           the mobile station transmitting an identification list comprising identifications of  
4 particular satellites thought to be in view, and identifications of particular sub-almanacs  
5 for each of the particular satellites;

6           the network estimating range errors for each of the particular sub-almanacs;

7           the network transmitting replacement sub-almanacs to the mobile station for each  
8 sub-almanac for which a predetermined range error threshold is exceeded; and

9           the mobile station calculating a coarse position using the sub-almanacs including  
10 any replacement sub-almanacs.

1           27.     The method of claim 26, further comprising:

2           the mobile station transmitting the coarse position and a new identification list to  
3 the network; and

4           the network calculating a final position solution for the mobile station.

1           28.     A satellite based positioning method for a mobile station in  
2 communication with a network, the method comprising:

3           the mobile station calculating which particular satellites the mobile station tracks;

4           the mobile station determining whether any sub-almanacs associated with the  
5 particular satellites are older than a predetermined maximum age;

6           if one or more of the sub-almanacs are older than the predetermined age, the  
7   mobile station transmitting to the network an identification list and an error threshold,  
8   wherein the identification list comprises identifications of particular satellites thought to  
9   be in view, and identifications of particular sub-almanacs for each of the particular  
10   satellites;

11           the network estimating range errors for each of the particular satellites; and  
12           the network transmitting replacement sub-almanacs for any satellites for which  
13   the range error exceeds the error threshold.

1           29.    The method of claim 28, further comprising the mobile station using  
2   stored data and any replacement sub-almanacs to acquire satellites and take  
3   measurements.

1           30.    The method of claim 29, further comprising:  
2           the mobile station calculating a coarse position;  
3           the mobile station transmitting the coarse position and an identification list to the  
4   network; and  
5           the network calculating a final position solution for the mobile station.

1           31.    A machine-readable medium having instructions stored thereon, which  
2   when executed cause a processor to perform a satellite positioning process, wherein the  
3   process comprises:  
4           using stored satellite sub-almanacs to acquire a plurality of satellites;  
5           using the satellite sub-almanacs to take measurements;

6           using the sub-almanacs to calculate a coarse position of a mobile station; and  
7           transmitting the coarse position to a network.

1           32.     The machine-readable medium of claim 31, wherein the process further  
2     comprises storing the coarse position, and transmitting the coarse position to the network  
3     after a period of time.

1           33.     The machine-readable medium of claim 31, wherein the process further  
2     comprises:  
3           calculating a correction to the coarse position; and  
4           transmitting the correction to the mobile station.

1           34.     The machine-readable medium of claim 31, wherein the process further  
2     comprises:  
3           determining whether any of the sub-almanacs require replacement; and  
4           transmitting and required replacement sub-almanacs to the mobile station.

1           35.     The machine-readable medium of claim 34, wherein the process further  
2     comprises transmitting an indication of an acceptable level of error to the network,  
3     wherein determining whether any of the sub-almanacs require replacement includes  
4     determining whether the acceptable level of error has been exceeded.

1           36.     The machine-readable medium of claim 31, wherein the process further  
2     comprises:  
3           receiving a reference position; and



4           using the reference position to calculate the coarse position.

1           37.     The machine-readable medium of claim 36, wherein transmitting the  
2     coarse position comprises transmitting a position difference between the reference  
3     position and the coarse position.

1           38.     The machine-readable medium of claim 33, wherein the process further  
2     comprises transmitting an identification list to the network, wherein the identification list  
3     comprises identifications of particular satellites used in calculating the coarse position,  
4     and identification of particular sub-almanacs for each of the particular satellites.

1           39.     The machine-readable medium of claim 38, wherein calculating the  
2     correction comprises calculating a position correction vector over satellites used to  
3     calculate the coarse position.

1           40.     The machine-readable medium of claim 38, wherein calculating the  
2     correction comprises calculating a pseudorange correction for each satellite used to  
3     calculate the coarse position.

1           41.     The machine-readable medium of claim 38, wherein calculating the  
2     correction comprises calculating a differential correction, wherein the differential  
3     correction accounts for discrepancies between calculation results obtained using  
4     ephemeris data and pseudorange data observed by a reference receiver at a known  
5     location.